

4.0 Project Evolution

CE Obsidian has drawn substantially on its successful operating history in developing the Amended Project. Additional consideration was given to the change in the marketplace for baseload, renewable energy between the times of the original and Amended projects. The criteria for development of the Amended Project included:

- Operational reliability
- Cost-effective construction
- Environmental sustainability
- Operational flexibility

As would be expected, the above considerations are somewhat interrelated.

4.1 Operational Reliability

At the time that the original project was conceived, a 185 MW geothermal turbine had not been constructed. In fact, there has not been a geothermal turbine of this size constructed to date. Consequently, many of the critical components would have been “prototypes”, i.e., custom fabrications with potentially unknown operational problems. This translated into a substantial cost increase in the engineering-procurement-construction bids. Additional review of the project and evaluation of all the risks of building the world’s biggest geothermal steam-turbine generator set lead to an unacceptable cost for the project to continue.

The project strategy for turbine size in considering the marketable power package size in terms of megawatts, time to construct, cost to build, and minimizing project risks led to a modular approach based on smaller turbine-generator sets that are proven in geothermal service. The concept was to replace the one prototype turbine-generator design with three smaller proven designs with reliable service records.

The new single-flash unit designs are simpler by process design compared to the one large triple-flash unit. The Amended Project’s design is generally based on a single-flash process that is installed at one of CalEnergy’s existing facilities. Brine handling equipment was greatly reduced by employing single flash technology which reduced capital costs and risks associated with construction and performance of triple-flash processing equipment. The Amended Project has the following major brine handling equipment: a high-pressure separator, a scrubber, and a demister. The turbine-condenser of the power block is a proven design operated at CalEnergy for many years. The brine processing and steam generation equipment described have a service record demonstrating tens of thousands of hour of reliable service. The new design of the Amended Project is expected to perform in a similar manner. The net effect will be to provide reliable delivery of clean, baseload renewable energy.

One ancillary equipment change is with the air emission control technology. The technology selected for the Amended Project is a recuperative thermal oxidizer (RTO). It was chosen for its ability to mitigate the operational constraints of the previously selected biological treatment system. Operation of the RTO system does not rely on maintaining the sensitive growth environment required for the biologic organisms to flourish. Additionally, the RTO can “load follow” and accommodate changes in the influent non-condensable

gas stream while maintaining consistent levels of destruction removal efficiency. The RTO technology was selected as an improvement to reliable emission control.

4.2 Cost-effective Construction

As mentioned above, several of the critical operating components of the original project would have been prototypes. As their reliability was unknown, this introduced an element of financial risk into the overall project. To accommodate this risk, it was CE Obsidian's intent at the time to demand performance guarantees of equipment vendors. While the vendors were willing to furnish these guarantees, the guarantees themselves would have become a substantial cost premium, which in turn would have increased the initial capital cost and associated debt service costs. Incorporation of the risk premiums for design and construction led to an unacceptable economic rate of return and the design strategy required rethinking. The Amended Project's critical components are "off the shelf" which substantially mitigates many of the previously stated issues. Performance guarantees for equipment, that has been successfully in service for years presents a minimal economic risk to the bidders, thus avoiding a cost premium.

The modular approach of the simple single-flash units allows for three plants to be co-located on one site and offer some economies of shared facilities. The new plant site configuration allows for some of the infrastructure components to be shared. These infrastructure items include: the control building, water storage tanks, fire fighting system, parking, and stormwater management pond. This approach improves the economics for building out to the permitted capacity while still maintaining a high confidence in reliable performance.

Another advantage of the three modular plant designs is minimizing the cost of facilities engineering and design. The construction is also more efficient, as the crews required to build one phase of the first unit can go on to build the first phase of the second unit, while construction of the first unit progresses to the second construction phase. This approach also facilitates the expected phased delivery of major critical-path equipment.

4.3 Environmental Sustainability

Although the main plant site associated with the Amended Project is larger than that conceived for the original project, the Amended Project configuration allows for the relocation of well pads away from Obsidian Butte and further from the wildlife refuge. This substantially reduces the potential for long term impacts to these areas from plant site operations. This in turn contributes to the operation's long term sustainability.

The original project would have relied on crystallizer, reactor, clarifier (CRC) technology to manage the spent geothermal brine. While this technology is performing well at several of CalEnergy's other operating plants, it is capital intensive from both a capital and operational standpoint.

The CRC technology would have produced a substantial quantity of solids on a daily basis from the spent brine. Management of these solids would have been energy intensive as well as requiring landfill space, and producing air emissions from truck transport of solids to the landfill. By using single flash technology that substantially avoids solids production from routine operations, the Amended Project makes the energy production process more environmentally sustainable on a long term basis.

4.4 Operational Flexibility

At the time the original project was developed, the renewable portfolio standard (RPS) in California was still evolving. An aspect of this was that there were limited “off-takers”, as the cost for renewable energy from the original project was substantially higher than fossil generated energy. In more recent years, the demand for renewable energy, driven primarily by the maturation of the California RPS, has increased dramatically as has the number of potential off-takers. By constructing multiple smaller plants, the Applicant can furnish renewable energy to off-takers with the flexibility to meet the desired amount of energy. The design allows for power purchase agreements for “bite-sized” amounts of power. Also, individual plants can be dispatched as needed for maintenance or to better accommodate system load constraints. Further, the ability to dispatch smaller plants on an individual basis if required enhances transmission grid stability compared to dispatching a single, large generating plant.